

According to two companies that are practicing this latter method, if the logs are placed up off the ground on poles and with pole stringers between each tier, there is little or no danger of blue-stain from the latter part of October to the middle of March.

December, 1933.

SOUTHERN FOREST EXPERIMENT STATION
U. S. Forest Service New Orleans, La.

NURSERY CONTROL OF THE BROWN-SPOT NEEDLE BLIGHT OF PINE SEEDLINGS

By

Paul V. Siggers,
Associate Pathologist.

Paul V. Siggers
NOT 100 DB

* - This series of publications releases data gathered in connection with investigations being carried on at the Southern Station. The information contained in them is subject to correction or amplification following further investigation. - Editor

NURSERY CONTROL OF THE BROWN-SPOT NEEDLE BRIGHT OF PINE SEEDLINGS*

By Paul V. Siggers**

Introduction

A widespread disease caused by the fungus *Septoria acicola* Thum.) Sacc. occurs in varying severity on the foliage of many of the southern pines. With the development of forestry in the Gulf States, this disease has attracted the attention of foresters and forest pathologists, particularly on account of its injurious effect on the early development of longleaf pine (*Pinus palustris*).

The first symptoms of the disease on healthy foliage are the formation of small spots which soon encircle the needle, as a narrow brown band with definite margins. This characteristic of the disease has given it the name "Brown-Spot" or "Brown-Spot Needle Blight." If the disease continues unchecked, the green tissue between the original spots becomes infected and the needles die back slowly from the tips, as the fungus makes its way down the leaves. By the end of a growing season, most of the foliage on badly infected seedlings may be killed, which greatly weakens the plants and makes them undesirable as planting stock. The presence of this disease in southern nurseries is a menace to the successful development of longleaf and slash pine (*Pinus caribaea*) seedlings. This disease is not considered of economic importance in the production of loblolly (*Pinus taeda*) or shortleaf pine (*Pinus echinata*) seedlings, as both species have demonstrated that they are highly resistant to the disease, even when exposed to repeated infection in nurseries.

This paper refers some of the writer's observations on the occurrence of the disease and its control by spraying in the field to nursery practice. There are few diseases of seedling trees easier to control under nursery conditions than the one considered here. On the other hand once nursery infection has started the presence of dense masses of susceptible foliage produces a condition highly favorable to the spread of the disease.

* In the preparation of this report the writer has drawn freely from the work of Mr. A. F. Verrall, formerly Field Aid, Division of Forest Pathology, Bureau Plant Industry, dealing with the occurrence of the disease under natural conditions in Washington Parish, Louisiana.

** Associate Pathologist, Division of Forest Pathology, Bureau of Plant Industry, U. S. D. A., in cooperation with the Southern Forest Experiment Station, U. S. Forest Service, New Orleans, La.

Observations on the Occurrence of the Brown-Spot With Reference to Nurseries

All of the native southern pines harbor the disease in varying degree and may undoubtedly serve to transfer the fungus to more susceptible stock when growing in or near forest nurseries. The writer knows of no instance where occurrence of the disease in nurseries in the South has not been associated with the presence in the immediate vicinity of one or more of the native southern pines.

Dissemination of the disease in nature occurs through the agency of wind and by the spattering of rain. The greater amount of infection in nurseries seems to be through the latter method of dissemination. The appearance of the disease in a nursery follows about two weeks after the infection of a single seedling or small group of seedlings. From these spots of initial infection the disease spreads rapidly, given favorable conditions for development, so that within a month infection among the beds may become general. Epidemics of the disease follow, particularly during periods of warm wet weather.

Rainy weather favors dissemination of the fungus spores (minute bodies analogous to the seeds of higher forms of plant life). However, for abundant spore production to occur, two or more days of rainy weather are needed. The ordinary spring or summer shower does not last long enough to open up the fruiting bodies of the fungus, which permits escape of the spores.

Fungicides Recommended for Disease Control

In the experimental control of the Brown-Spot Needle Blight under field conditions, Bordeaux Mixture and Lime Sulphur have consistently given the best results. They are the only fungicides considered in this report. Both are obtainable commercially in powdered form and their homemade preparation is also well understood by most nurserymen.

Composition of Spray Solutions

Where beds of longleaf or slash pine seedlings are known to be exposed to the disease, Bordeaux Mixture (5-5-50) or Lime Sulphur (2.5-2.5-50) are recommended. Without impairing disease control, the solution strengths indicated may be reduced one-fifth during periods of dry weather.

In spraying coniferous foliage with aqueous solutions, it is necessary to add an adhesive at the time the solutions are made up to prevent undue loss of the fungicide. Whale oil soap, casein spreader, and raw linseed oil have been used for this purpose. Two pounds of whale oil soap or casein spreader should be added to every 50 gallons of spray solution. In field tests to determine the minimum number of treatments needed to control the Brown-Spot on planted seedlings, raw Linseed Oil has been

employed with success as an adhesive for Bordeaux Mixture. It should be used at the rate of 5 quarts in 50 gallons of solution. It should not be added to solutions of Lime Sulphur. The Bordeaux Mixture and Linseed Oil spray is not easy to make up and its preparation will be discussed later.

Preparation of Sprays and Their Rate of Application

When ready mixed powders are used the required amount of powder is weighed out and stirred into a given quantity of water. For those who are interested in making up their own sprays, directions for making up these widely used fungicides may be found in any handbook on nursery practice. In large scale operations, it is not desirable to make up more solution than can be used in a day.

For treating an acre in solid nursery beds, from 165 to 185 gallons of solution should be needed, depending on the amount of disease present and the density of the stand. If applied at the rate of 175 gallons per acre, 4 gallons would cover almost a thousand square feet. At the same rate, 0.51 ounces of spray solution would be used per square foot.

When properly prepared, Bordeaux Mixture with Linseed Oil adheres to coniferous needles for months at a time. Preparation of this spray is difficult because it is hard to emulsify the oil. The only way to accomplish this is to pour the mixture into a pump and force it back under pressure into an open container. The resulting solution will then be ready to spray on the foliage. Because this solution often lacks uniformity it is not desirable to prepare it in amounts exceeding 10 gallons at a time. The following formula is suggested:

Table 1. - Formula for Bordeaux Mixture-Linseed Oil Spray

Bordeaux Mixture (powdered)	2 pounds
Raw Linseed Oil	1 quart
Water	9-3/4 gallons

After using this solution some solvent of Linseed Oil (such as gasoline) should be forced through the pump to eliminate the film of oil inside. If this is not done, the nozzle and valves will become badly clogged when the oil dries up. A final rinsing with water will put the spray equipment in condition for the next treatment.

Periodicity of Treatments

Where nurseries are under the constant supervision of men who are familiar with the symptoms of the Brown-Spot Needle Blight, spraying may be deferred until the disease starts to appear on the needles. However, for the sake of avoiding an epidemic of the disease, spraying

is always advisable as soon as there is any doubt about the proper time to start.

As a routine measure, spraying should start when the secondary leaves have reached a third their mature length. The number of treatments needed during a season will depend on the kind of adhesive used. Spraying at monthly intervals is advisable when casein spreader is used. During periods of rainy weather it may be necessary to shorten this interval to three weeks. If the Bordeaux Mixture and Linseed Oil spray is used, three applications during a growing season may be expected to give good, although not necessarily 100 percent control. When as few as three applications are made during a growing season, some spotting may appear on the foliage, particularly if the seedlings are exposed to infection by the presence of the disease on unsprayed stock nearby. At most nurseries in the Gulf States it is advisable to start spraying in May and finish in October.

Burning of Foliage with Lime Sulphur

Ready mixed Lime Sulphur when used at the rate of 6-1/4 pounds in 50 gallons has caused burning of longleaf foliage in nurseries and on natural reproduction. This injury is favored by periods of dry weather, when oxidation of the dried spray residue occurs under the action of bright sunlight. By reducing the strength of the solution further injury to the foliage has been avoided.

Cost of Treatments

The cost of bringing a crop of seedlings to planting size in disease-free condition will, of course, vary with the number of treatments, the rate of application, and the cost of labor and chemicals. To this should be added a small charge for depreciation of spray equipment. The cost of increased supervision in this work has not been considered, because once nursery spraying becomes routine practice there is nothing involved that intelligent day labor cannot do. Undoubtedly the cost of the solutions can be reduced by a third or more, provided they are made at home.

In the following tabulation of costs, the item of labor is set at \$2.50 per day. This may appear high, but it is not too high for a man who can be trained to properly spray nursery seedlings without supervision. With an ordinary four gallon, compressed air, hand-sprayer and with solutions ready to mix, one man should be able to cover half an acre of nursery beds in one day.

The cost of chemicals is based on the following prices per pound for the powders:

Bordeaux Mixture	9-1/2 cents
Lime Sulphur	15 "
Casein Spreader (as an adhesive)	29 "
Raw Linseed Oil (" " ")	75 " (per gallon)

Table 2. - Cost per treatment per 1,000 square feet of solid nursery bed.

	With Casein Spreader Adhesive	With Linseed Oil Adhesive
Labor	\$.12	\$.12
Chemicals:		
Bordeaux Mixture	.12	.15
or		
Lime Sulphur	.11	
Depreciation	.01	.02

When the rate of application is 4 gallons per thousand square feet of solid nursery bed, the cost of 6 treatments of Bordeaux Mixture would be \$1.50 and of Lime Sulphur \$1.44. Bordeaux Mixture with Linseed Oil as an adhesive would cost \$.87, if used three times during the growing season.

Summary

Serious outbreaks of a foliage disease of longleaf and slash pine seedlings have occurred in forest tree nurseries in recent years.

The disease is easily controlled by the systematic application of Bordeaux Mixture (5-5-50) or Lime Sulphur (2.5-2.5-50).

Depending on the number of treatments and the kind of spray used, the annual cost of controlling the disease, at the specified rate of application, should vary from \$.87 to \$1.50 per 1,000 square feet of solid nursery bed.